COMPOSITION AND NATURE OF THE VENEZUELAN PTERIDOPHYTE FLORA

Francisco Ortega and Raul Rivero
UNELLEZ - Guanare
Programa de Recursos Naturales Renovables
Herbario Universitario

Resuaen

Se analiza la flora pteridofítica venezolana, tomando en cuenta el número, composición y distribución de los géneros y especies presentes. Mediante un análisis comparativo de los diferentes trabajos globales previos (Adolf Ernst en 1977, Henri Pittier y colaboradores en 1945, Volkmar Vareschi en 1969 y Alan Smith en 1985), se ha podido determinar el grado relativo de evolución de los conocimientos que de la flora pteridofítica venezolana se tiene. Se analiza la distribución de las pteridofitas de acuerdo a su incidencia en las seis áreas de mayor concentracion de especies del país: Cordillera de Los Andes, Sierra de Perijá, Sierra de San Luis, Cordillera de la Costa, Tierras Altas de Guayana y el territorio insular venezolano (Isla de Margarita y

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Archipielago Los Testigos). Para la flora pteridofítica venezolana se

reconocen aquí 1.169 taxa; un número considerable de ellas son nuevas para la ciencia (aprox. 27) y 158 son endémicas. Se hace un análisis de la flora en el contexto de otras previamente realizadas en el Neotrópico.

Abstract

The number, composition, and distribution of genera and species of pteridophytes are analyzed. The state of the advancement over what is known about the Venezuelan fern flora has been summarized using a comparative analysis of the different previously published global treatments (Adof Ernst in 1877, Henri Pitiier and collaborators in 1945, Volkmar Vareschi in 1969, and Alan Smith in 1985). Pteridophyte distribution is analyzed according to occurrence within the six major species concentration areas of the country: The Andean Cordillera, the Sierra de Perijá, tha Sierra de San Luis, the Cordillera de la Costa, the Guayana Highlands, and the Venezuelan islands territories (Isla de Margarita and Archipielago Los testigos). 1,169 taxa are recognized for Venezuela of which a considerable number (aprx. 27) are new species. Floristic analysis presented here is based on the contexts of other previously published for Neotropical regions.

INTRODUCTION

Recent taxonomic revisions and renewed interest in botanical collecting in Venezuela have made it possible to considerably improve our knowledge of the pteridophytic flora of the country. In this report we review previous studies on Venezuelan ferns, the recent taxonomic revisions of particular groups, and other regional or Neotropical floras. The first attempt to systematize the Venezuelan pteridophytic flora was by Ernst (1873), more than a hundred years ago. The first modern treatment reviewing Venezuelan ferns was published by Vareschi in 1969.

Fern research in Venezuela in still in a dynamic state, considering the recent and abundant literature and the numerous collections made by several botanist deposited in national and international herbaria.

The essential data source for this report was "Pteridophyte of Venezuela: An annotated List", by Smith and collaborators (1985), which includes an update of the taxa of Venezuelan pteridiophytes.

METHODOLOGY

It is not possible to make a detailed analysis of the phytogeographic situation of each particular area because of the large number of taxa currently reported for the Venezuelan pteridophytic flora today. It is for this reason that statistical data are presented in this report to describe the different biogeographic zones of the country.

The procedures to produce this analysis include the following activities:

1. Review of the essential historic literature as well as those works related to each of the relevant phytogeographic areas.
2. Review of all literature associated with Pteridology in Venezuela.
3. Visits to those herbaria with important collections of Venezuelan pteridophytes: VEN, PORT, MER, NY, UCOB, La Salle (Caracas) and UC.

FINDINGS

Historic Aspects of the Venezuelan Pteridophytic Flora:

It has been a very long time since Petri Loefling visited and collected plants in Venezuela between 1754 and 1756. Since that time botanical explorations have been continuous and the findings have been recorded in numerous publications.

The first systematic studies on the Venezuelan flora were carried out by Adolfo Ernst (1861-1899), who for almost 38 years in this country did an extraordinary scientific work, not only in botany but also in zoology and geology. In fact, his publication "Filices Venezuelanae" (a systematic enumeration of Venezuelan ferns), edited in 1877, marks the beginning of Pteridology in Venezuela. Ernst in his report included an analytical list of 44 genera and 399 species known at that time. The findings presented in that report are an improved and updated reprint of a previous publication of 1873 in which he reported 447 taxa. Ernst (1877) explained that the difference in the number of species is due to "difficulties in the circumscription of the species and the large discrepancies existing in the works of other authors."

One of the most important advances in the botanical research in Venezuela is Pittier's "Plantas Usuales de Venezuela" (Common Plants of Venezuela) published in 1926. In this publication the author listed 6037 species of spermatophytes and pteridophytes. The Venezuelan Flora Catalog

(Pittier et al., 1945) represents the second taxonomic treatment of the Venezuelan pteridophytes. There, in addition to the key for the 80 genera reported, a list of 791 species is included.

The numerous and extensive collections were a result of the creation of the National Herbarium. The beginning of the Venezuelan Flora Project in 1965 established the basis for the first modern treatment of Venezuelan ferns (Vareschi, 1969). This two-volume publication includes 26 families, 100 genera and 980 species. It is necessary to point out that this work includes numerous illustrations that are of great assistance to the user.

For the last ten years intensive exploration programs have been implemented in different areas of the country and have resulted in the publication of several regional floristic studies. These efforts have brought about a remarkable increase in the pteridophytic taxa known in Venezuela.

In 1985 Smith and several collaborators (including the authors of the present report) published a review of the Venezuelan fern flora. It includes a total of 1059 recognized species, in addition to 24 varieties, approximately 59 new putative species and 37 unnamed species. Most of these additional taxa are still undescribed. This review was published using a computerized word processor which allows the inclusion of new records, facilitating the correction and updating of the taxonomy of any fern group during the process of the review. Figure 1 compares the number of species recognized in past and present account of Venezuelan pteridophytes in the 11 largest genera which 57 % of the total fern flora. Unfortunately, Ernst (1873, 1877) did not include data for the genera Lycopodium and Selaginella.

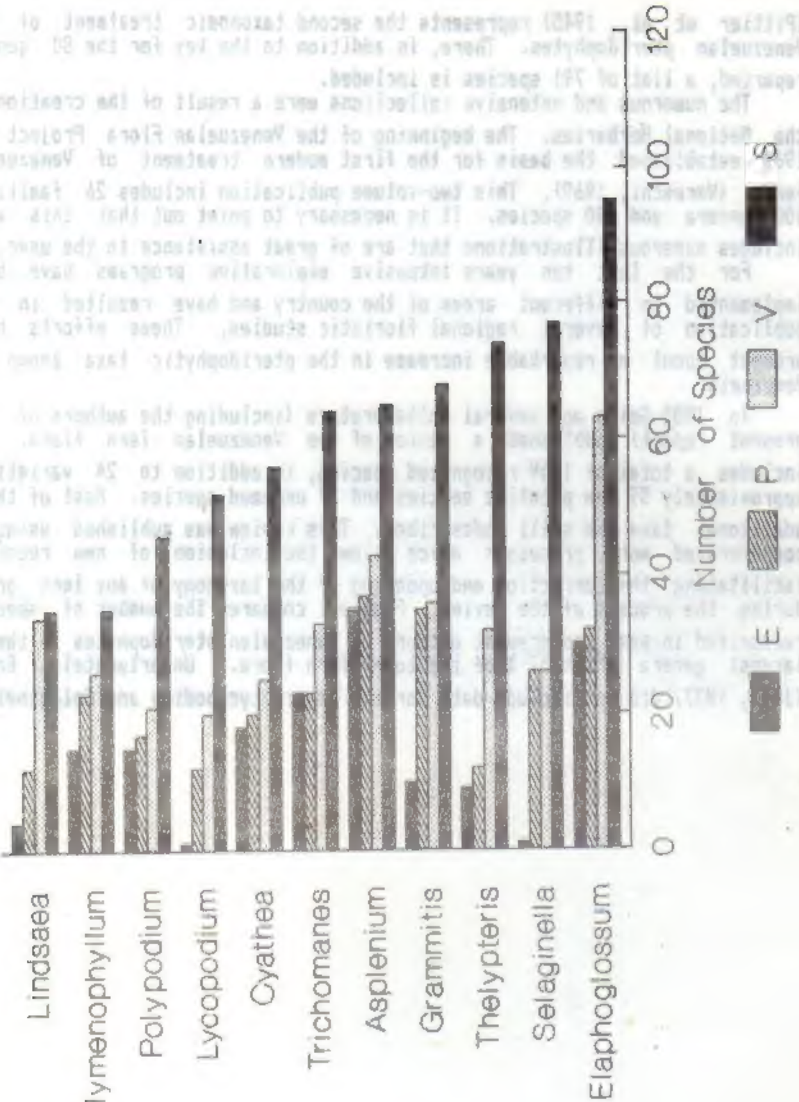

Figure 1.- Number of species recognized in past and present account of Venezuelan pteridophytes in the 11 largest genera which 57 % of the total fern flora.
E: Ernst P: Pittier V: Vareschi S: Smith

Biogeographic aspects:

Venezuela occupies an area of 912,050 km^2. It is located between 0° 45' and 12° North latitude. Elevations range from sea level to 5007 m in the Cordillera de Los Andes.

Topographic barriers and edaphic or climatic factors, account for great diversity in species, which tend to concentrate in several phytogeographyc areas (Steyermark, 1979a).

Taking into account this biogeographic zonal distribution it is possible to divide the country into five relevant areas within the continental territory and one in the insular territory (Figure 2). They are listed as follows:

1. Andean Mountains (Cordillera de Los Andes).
2. Coastal Mountains and the Interior Range (Cordillera de la Costa).
3. Perijá Range (Sierra de Perijá).
4. San Luis Range (Sierra de San Luis).
5. Guayana Highlands
6. Isla de Margarita y Archipielago Los Testigos.

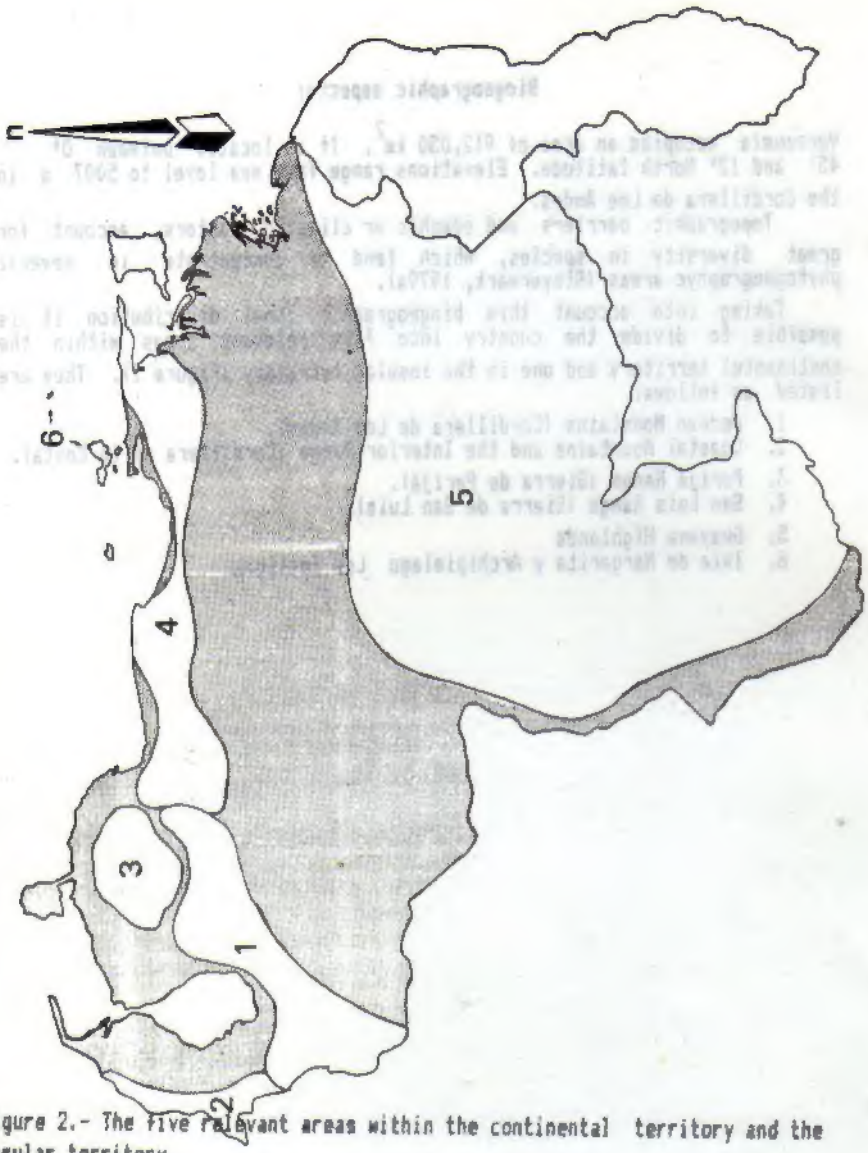

Figure 2.- The five relevant areas within the continental territory and the insular territory.

1. Andean Mountains.
2. Coastal Mountains and the Interior Range.
3. Perijá Range.
4. San Luis Range.
5. Guayana Highlands.
6. Isla de Margarita y Archipielago Los Testigos.

CORDILLERA DE LOS ANDES

Los Andes are located in the west of Venezuela. They are a narrow range, 50 X 450 km, with a northeast-southeast orientation. The Venezuelan Andes are separated from the Colombian Andes by a depression located at the border between the two countries. This is the lowest elevation (800 m) in the entire range that begins in Chile. In Venezuela, the high mountains begin with the Páramo de Tamá in the west end of the country. They extend in an "island" mountain formation up to the spur of the Coastal Mountains in the midwest of the country. These two ranges present sharp differences in their genesis and discontinuities in the northeast and are marked by the tectonic elevation of the Turbio and Yaracuy rivers (Schubert, 1977; Steyermark, 1979a).

The geological history of the Venezuelan Andes has been discussed by different authors (Van der Hammen, 1961; Simpson, 1975; Salgado-Labouriau, 1976; Cleef, 1979). They all agree on the recent origin of the mountains and their continued increase in elevation.

The vegetation of this area has not been studied in depth. There are, however, several studies that show area to be a refugium and dispersal center (Steyermark, 1979a, 1982; Ortega et al., 1986).

Despite the numerous ferns collected since the second half of last century by botanists such as Karl Moritz in 1835, Jean Jules Linden in 1842, Nicholas Funck in 1845, and Hermann Karsten at the beginning of the 1850's, no list of pteridophytes has been published. The first reference to this group of plants is found in Goebel (1891). His publication is the result of his expedition to Mérida in 1890. Later Kunth (1926) cited a list of 104 pteridophytes of the Venezuelan Andes. The first study to analyze the pteridophytes of the Venezuelan Andes from the fitogeographic point of view is Ewan's (1950). In his work he studied the ecology of the Páramos and Pico Bolívar. Pannier (1952) carried out the first comparative study between pteridophytic flora of the Andes and the flora of the Coastal Mountains. He compared the distribution of ferns in relation to the elevational gradient.

The most important source for the study pteridophytes of the Venezuelan Andes is Vareschi (1956, 1970) and the work of Duek and Rincón (1978), in which the first computerized data base for the flora of Estado Mérida is presented.

At present, the pteridophytic flora of the Venezuelan Andes is made up of 642 taxa of which 368 are only found in this area.

SIERRA DE PERIJA

The Perijá Range in Estado Zulia consists of a sliver of the northwest Colombian Andes in Venezuela which is the northern tip after the branching

off at 7° 30' north latitude at the Pamplona knot. Its mountains form the frontier between Colombia and Venezuela. Only the eastern side of this range is present in Venezuela. This long Andean flank of approximately 250 km borders the Maracaibo Lake depression, which is a plateau at 100 m. The highest mountains of the Perijá Sierra reach 3750 m (Pico Tetari).

Elevating in the late Pleistocene, the geologic history of the Perijá Sierra shows remarkable differences with the rest of the Venezuelan Andes (Steyermark, 1979). Studies on the ecology of this formation have shown a large number of species and vegetal coverage (Smith, 1985). Eighty percent of the vegetation is forest and human intervention is hardly noticeable in the narrow valleys and at lower elevations. Small ranchers and farmers have established themselves in the area (Aristeguieta, 1985). A large area of the Perijá Sierra is now protected by the federal government as a national park.

The first compilation of the flora of the Perijá Sierra was published by La Salle Natural Science Society in 1953, in which 62 pteridophytes were listed. Later, Tillett (1978) began publishing a series of articles on the vascular plants in the region (Tillett and Berry, 1983; Tillett et al., 1985). Recently, Steyermark and Delascio (1985) published an extensive work on the flora of the Perijá Sierra and its phytogeographic relations, listing 107 pteridophytes. At present, 146 taxa are recognized for the region, six of them are only known in that zone and are not found anywhere else in Venezuela.

SIERRA DE SAN LUIS

The San Luis Sierra is located in the northern region of Venezuela in Estado Falcón, between 11° 15-20' north latitude and 65° 43-55' west longitude. It is separated from the two great mountain ranges of Perijá and the Andes by small forests and isolated sierras. It is approximately 35 X 7 km with very steep hills and peaks as high as 1500 m.

After an analysis of the geological history of this sierra, Steyermark (1975) concludes that it is a relative young formations that emerged long after the Coastal Range and the Andean Mountains. A large part of its flanks and valleys have a sedimentary submarine origin and probably its maximum elevation was reached at little over a million years ago.

At present, the San Luis Sierra contains the very few natural forest sites that still exist in Falcón. In his preliminary report on the flora of the State Falcón, Wingfield (1984) warned us about the process of intervention and destruction that is taking place in the area. Both Steyermark (1975) and Wingfield (1984), have pointed out the importance of the diversification and endemism present in the mountains. Taking into consideration the vegetation, the hydrology, and other factors, they

suggested protective measures for the area.

Many botanists have studied the plants of the San Luis Sierra (Wingfield, 1984); it is worth mentioning the first one Hermann Karsten, who in 1852 was the first to collect and describe new species in this area.

The first flora on the San Luis Sierra was published by Steyermark (1975), who commented on its phytogeographyc importance, and origin. He included a list of 44 pteridophytes. Another work dedicated exclusively to the pteridophyte flora of the Estado Falcón was by van der Werff and Smith (1980), who list 216 taxa. Recently, Wingfield (1984) reported 201 taxa of pteridophyte for the San Luis Sierra.

At present a total of 193 taxa are recognized for these mountains. Seven of them are only found in this zone in Venezuela.

CORDILLERA DE LA COSTA

The Coastal Mountain Range is the longest in Venezuela. It is made up of a series of mountain ranges extending more than 1000 km. The range begins at the separation from the Andes in the Yaracuy depression and extends to the Peninsula de Paria in the eastern part of the country. As previously mentioned the Coastal and the Andean mountain ranges have very different geologic histories.

The Coastal Range began its elevation during Cretaceous with continuous elevation periods during the Pliocene epoch (Steyermark, 1979). The range extends in an east-west direction, with some lateral branching. The most important of these branches is the Serrania del Interior, which is partially isolated.

The highest mountain of the Coastal Range is Naiguatá Peak (2765 m). The vegetation on the mountain cap is sub-páramo, which represents the easternmost site for this type of vegetation in Venezuela (Steyermark and Huber, 1978). The ecology has been studied in detail by Aristeguieta and Ramia (1951) and Vareschi (1956).

Most of the high hills of the Coastal Range are covered with cloud forests and those studied have been found to be refuges and dispersion centers (Steyermark and Agostini, 1966; Steyermark, 1973).

One of the most remarkable aspects of the flora is its variety. This is due to the fact that both sides of the range are influenced by different environmental factors. These influences are easy to discover when we analyze the phytogeographic relations and the physiognomic and floristic contrast between both sides, north and south, of the range, (Steyermark, 1974; Steyermark and Huber, 1978).

Among the first botanists to collect plants from the Coastal Range are Bredemeyer, a German gardener, who collected between 1786 and 1788. Later case Humboldt and Bonpland in 1795. A large number of botanists have

studied the flora of the Coastal Range. In spite of that, there is no complete publication that includes all the species present in that zone. There have been local and regional studies, among which we should mention Badillo et al., (1984) and Berry and Steyermark, (1985). The most important work on the flora of the Coastal Mountain range is, undoubtedly, Steyermark and Huber (1978) which contains a list of 151 pteridophyte species. Other studies from this region also have yielded preliminary information concerning fern spores (Tschudy and Tschudy, 1965). At present, the number of taxa in this range reaches 525, of which 87 are found only in these mountains.

GUAYANA HIGHLANDS

The term "highlands" is used in this paper to follow the English bibliography instead of the word "alturas" used by Steyermark (1975). The term includes all the area south of the Orinoco River with elevations averaging 1000 m. They are located in Edo. Bolivar and the Territorio Federal Amazonas with more than 80,000 km^2.

Thus the vegetation of the "tepuyes" (sandstone plateaus) would be included in the species concentration center referred by Steyermark. These formations are the remants of great and continuous masses of sediment of the Precambrian Era. Their age ranges from 1,500 to 1,800 million years. The group of these mountains has been named by Mayr and Phelps (1967) "Pantepuy" and the total area is 5,000 km^2. We have used here the same unifying .pa floristic criterium calling the whole area as a "highlands," based on that a high percentage of genera present at the top are also found in the lower lands (Steyermark, 1979).

The Guayana Highlands are an enclave of ancient flora with a high occurrence of endemic elements. The origin and development of this zone has been discussed by several authors (Maguire, 1970, 1979; Prance, 1978; Steyermark, 1978, 1982), who concluded that the area has undergone important climatic and geological changes, going from very cold to very warm periods and from dry to very humid periods, due to the glacial and interglacial phases that occurred during the Pleistocene and Recent Epochs.

Interest in the flora of this region began with von Humboldt and Bonpland who arrived in this country in 1800. Undoubtedly this is the flora that has received the most attention by botanists in Venezuela. Huber and Wurdack (1984) prepared an extensive chronology of the area that dramatizes the intensity of the botanical exploration of the Guayana Highlands.

At present, a number of works relating to the area have been published. Emphasis has been on the slopes and tops of the "tepuyes." Most of these have been published in the journal **The Botany of the Guyana Highlands**, edited by Wurdack (1953), of which more than 12 volumes have already been

published.

The first pteridophytes reported from the Guyana Highlands were collected by Richard and Robert Schomburgk in Roraima and were published by John Smith in 1842 (Morton and Lellinger, 1966). Works on pteridophytes reflec the results of recent explorations. Lellinger (1967) published a revision of **Pterozonium**, which is the most conspicuous and peculiar genus of America; in addition it also contains many endemic species in the Guyana Highlands. This work is completed through the treatment of the Schizaeaceae, Hymenophyllaceae and Hymenophyllopsidaceae families and Adiantoideae and Vittarioideae sub-families (Lellinger, 1969, 1972, 1984). The total number of species is 547, out of which 238 are characteristic of this area.

INSULAR TERRITORY

Margarita Island and Los Testigos Archipelago have been included in this paper because they are the only islands in Venezuela with primary vegetation and habitats that allow the presence of pteridophytes. As a whole these islands may have served as a "bridge" during the floristic movements of the past (Ortega, 1982).

Isla de Margarita: This island (area 933.8 km^2) is the largest and most important island of Venezuela. It is located in the eastern region of the country and its mountains reach an elevation of 910 m. It is 32 km from the Paria Peninsula.

The geologic history of the island is very closely related to the Coastal Mountain Range (Ortega, 1982); it was part of the continent several times during the last three million years. Ortega (1982) in the analysis and geographic distribution of the ecology determined the possible origin of the pteridophytes of the island. The conclusion was that a high percentage of them come from the continent.

Ernst (1881) published the first list of plants for Margarita Island as a result of his observations during May 1873. There are no pteridophytes included in the 242 taxa reported. Later, Johnston (1905) visited the island in twice (1901 and 1903) and published an extensive work on the flora of Margarita Island, in which 60 species of pteridophytes were reported.

New additions from Margarita Island to the Venezuelan flora were published by Steyermark and Ortega (1981) and a phytogeographic analysis of the pteridophytic flora published by Ortega (1983) included a total of 84 taxa. Hoyos (1985) published an study of the flora of Margarita Island reporting 39 genera and 89 species. Seven of these species are found only on Margarita Island.

Archipielago Los Testigos: It is formed by 17 small islands located in the

northeastern region of the Venezuelan continental platform, 68 km north of Rio Caribe, Edo. Sucre and 40 km east of the Isla de Margarita. Its geographic location is 10° 20' north and 63° 09' west. The total area of the archipelago is 5.9 km^2 with an elevation up to 200 m in Testigo Grande Island, the largest of all.

The most remarkable geographic and geologic aspects of the islands have been presented by several authors (Vila, 1967; Schubert and Moticska, 1973; Williams 1980; Olivo, 1984; Fernandez and Ortega, 1986). The archipelago is geologically related to La Sola and Los Frailes islands off the eastern coast of Margarita Island through a linear volcanic activity that took place during the Higher Cretaceous Period. It is also very closely related to the continental Venezuelan platform.

The ecology of the vegetation of the archipelago, as well as the review of the history of the botanical collection was published by Fernandez and Ortega (1986). This is the only work where pteridophytes of the archipelago are mentioned. Seven taxa were reported. One of them is only found in the archipelago and nowhere else in Venezuela.

VENEZUELAN PTERIDOPHYTIC FLORA IN A NEOTROPICAL CONTEXT

After determining the number of taxa present in the six areas of species concentration in Venezuela, taxonomic diversity are analyzed and compared with the characteristics of other regions where floristic inventories have been performed.

Figure 3 shows a summary of the taxonomic composition of the pteridophytic flora present in Venezuela. As we have shown, the majority of the pteridophytic flora in Venezuela is concentrated in six different mountain ranges. The remarkable finding is that in spite of the large capacity of dispersion of spores of ferns and the short distances between areas (less than 1,000 km between the most distant ones), there are many species that characterize such regions.

A detailed analysis of the floristic composition of each one of the regions is outside the scope of this paper, but it must be pointed out, nevertheless, that there are numerous cases of discontinuity and disjunctions. The most remarkable cases of concentration of species are in the Andes Mountain Range and the Guayana Highlands, where genera such as Jamesonia, Pterozonium, and Hymenophyllopsis make evident that these areas are centers of speciation.

On the other hand, the geologic history of these centers and the recent biogeographic studies show that the ecosystems present in the higher parts of the Andean mountains and the

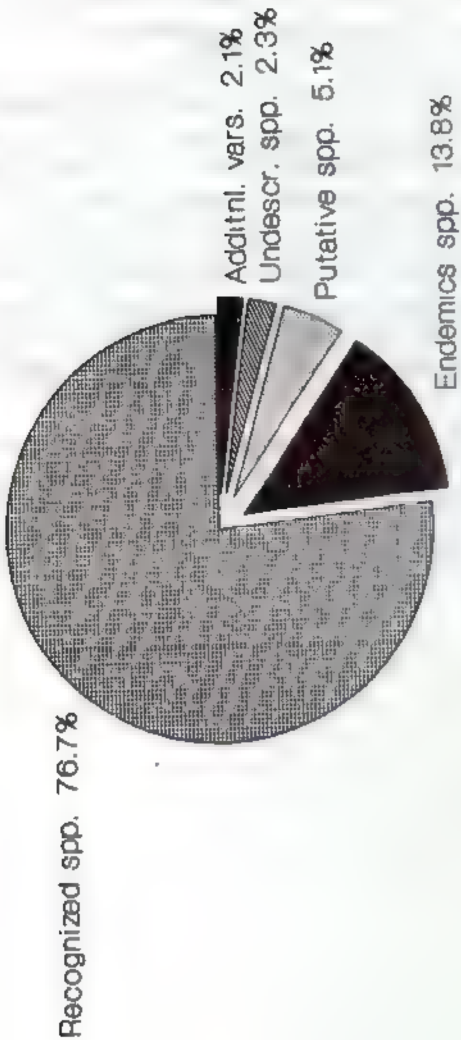

Figure 3.- Summary of the taxonomic composition of the pteridophytic flora present in Venezuela.

Sandstone Mountain Tables (Tepuyes) of the Guayana Highlands behave like "islands," with very well defined environmental characteristics (soils, climate, hydrology etc.) that determine the adaptation and distribution of particular species to those orographic formations.

The fern species of tropical America are concentrated in four large biogeographic regions with a high density and a marked endemism. These regions are: 1. Major Antilles, 2. southern Mexico and Central America, 3. the Andean region and 4. southeastern Brazil. The Guayana Region whose center is Edo. Bolivar and encompasses Surinam (Tryon, 1979; Tryon and Tryon, 1982) is considered a separate and an additional region.

From the extensive floristic literature on the region, necessary as a source of biogeographic data for comparative purposes, we have selected those works that best represent the identified regions. The data used in the following comparisons were taken from Smith (1981) for the southern Mexico, Stolze (1983) and Wagner et al. (1969) for Central America, Proctor (1985) for the Major Antilles, Sehnem (1977) for Southeast Brazil and Kramer (1974, 1978) for the Guayana Region.

The data presented in table 1 illustrate the essential characteristics of each one the regions considered in this analysis. Whereas the number of genera present in each region has few fluctuations, the number of species is much more variable and is not proportional to the area of each region. This is more noticeable in Jamaica y Costa Rica, e.g.

Table 1.- Characteristics of some regions considered in the neotropical context.

REGION	GENUS	ESPEC.	E/G	A. km^2	E/A	REFERENCE
Chiapas (South of México)	108	699	6.45	191.842	3.64	Smith, 1981
Guatemala	101	652	6.45	110.000	5.92	Stolze, 1983
Jamaica	83	609	7.34	11.470	52.95	Proctor, 1985
Costa Rica	100	912	9.12	50.899	18.00	Wagner et al. 1969
Surinam	63	699	11.10	191.642	3.64	Kramer, 1974; 1978
Southern Brazil ‡	72	526	7.31	578.000	0.91	Sehnem, 1977
Venezuela	109	1167	10.70	912.050	1.27	Smith, 1985

E/G: Especies/Genus

E/A: Especies/Area

‡ : Brazilean states Rio Grande do Sul, Santa Catarina, and Paraná

‡

The mean value of the relation species/genera (S/G) is remarkably higher in Surinam, Costa Rica and Venezuela, where it reaches 11.10, 10.70 and 9.12 correspondingly. In the case of Surinam, the similitude with Venezuela is due to a decrease of approximately 41% of the number of genera and species. These coefficients decrease progressively in the following order: Jamaica, southern Brazil, Chiapas and Guatemala.

Comparing the diversity of genera and species within absolute values or expressed in coefficient terms S/G, it is evident that Venezuela is the country with the most diverse pteridophytic flora.

When comparing the taxonomic diversity with the geographical area, we find that Jamaica and Costa Rica have the highest S/A coefficients (number of species/area). If we consider that Venezuela is about ninety times bigger than Jamaica and twenty times bigger than Costa Rica, we must conclude that the number of species in Venezuela is considerably higher. Only southern Brazil has a similar S/A coefficient.

CONCLUSIONS

1. It is obvious that the degree of evolution of the knowledge about pteridophytic flora in Venezuela has reached a stage where it is possible to permit some broad generalizations and a comprehensible panorama. Comparing the work of Smith (1985) with previous works the additional number of pteridophyte taxa recognized in Venezuela is remarkable. It true, however, that the more taxonomists study the flora of a region the more the diversity of species in the region will be noticeable in comparison with less studied areas (Tryon, 1985). Therefore, the results are logical and reflect the reality of the botanical investigations in Venezuela and in tropical America. The numerous revisions and treatments performed on complex groups such as Elaphoglossum, Cyathea, Selaginella, and Lycopodium have resulted in a more precise delimitation of the species and the publication of new taxa.

   Another important fact that must be highlighted is that the degree and quality of the collection may influence the points of view about the relative diversity of the observed vegetation. The historic references quoted in this paper that have served us as a starting point for our analysis were performed by botanists who were not exclusively dedicated to pteridology. This is the contrast with the work by Smith (1985) that was performed by specialists.
2. The large number of the pteridophyte species in Venezuela is due, to a certain extent, to the presence of two mountain ranges related to two speciation areas: Andes and Guayana. Venezuela also presents a kaleidoscope of ecologic environments that offer possibilities for allopatric speciation.
3. Except for the Guayana Highlands, Venezuelan mountains are recent. In any case, the post-pleistocene climate has been mild and with minor changes that have not prevented massive extinctions. According to Tryon (1985) the largest vegetational diversity occurs in tropical mountains with this characteristics.

   The recent geographic isolation of the Coastal Mountain Range, the San Luis Sierra and the Insular Territory, plus the dispersal ability of pteridophytes, allowed contact and migration among the different regions preventing isolation and the stablishment of an abundant endemic flora. The Andes and the Guayana Highlands are different cases. Isolation and the existence of a variety of environments have given way to the formation of a characteristic and endemic flora. Finally, the absence of sudden seasonal changes and the existence of a long rainy season in the Venezuelan mountains is probably the fundamental cause for the existence of an abundant and varied flora.

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